"So, How's the Water?" - Analyzing Long Term Water Quality Trends in Indiana Streams

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Indiana Department of Environmental Management

Office of Water Quality
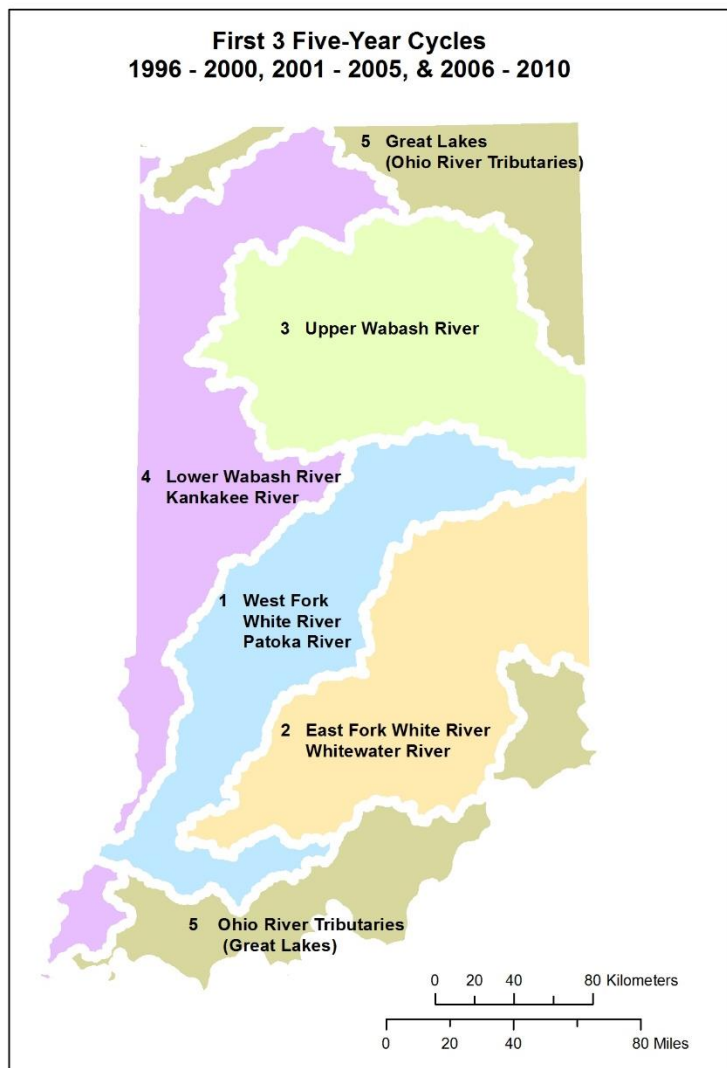Watershed Assessment and Planning Branch

Objective

- "Each state shall prepare and submit … a report which shall include … a description of the water quality of all navigable waters in such State during the preceding year …" [CWA § 305 (b)(1)]

- "…restore and maintain the chemical, physical, and biological integrity of the waters of the state." [327 IAC 2-1-1.5]

- "All waters … will be capable of supporting a well-balanced, warm water aquatic community" [327 IAC 2-1-3]
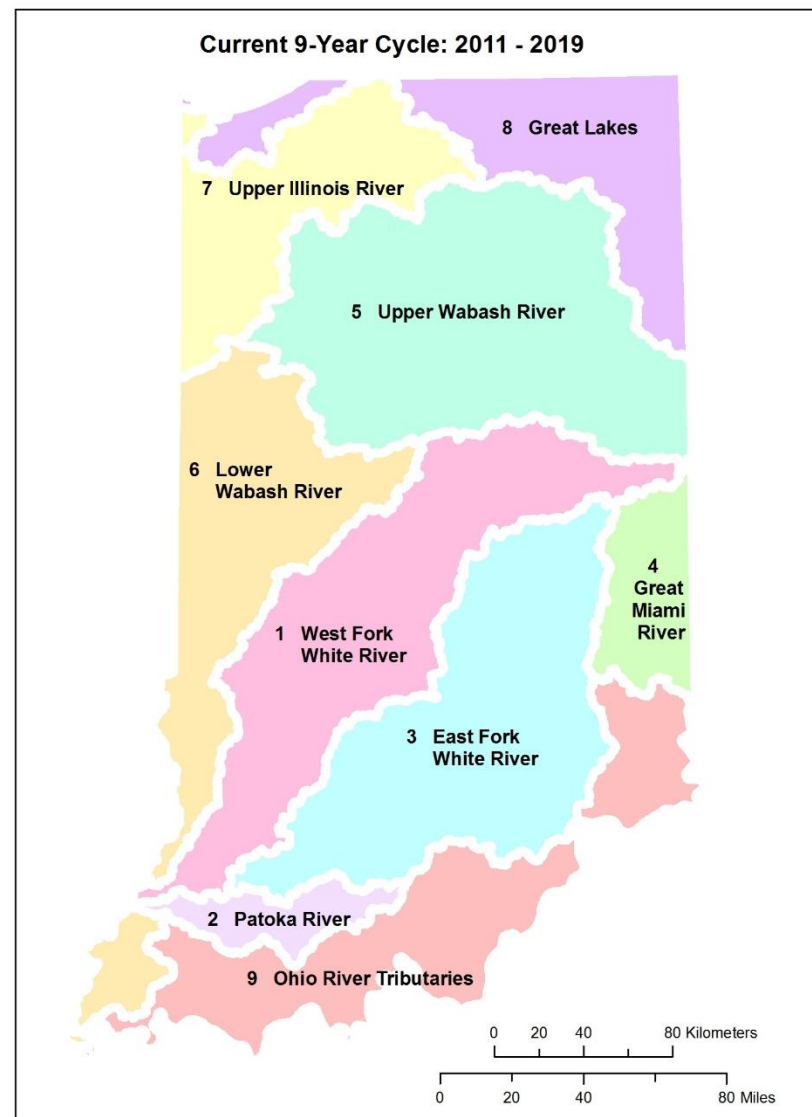
Probabilistic Sampling Design

- Probabilistic design provides statistically valid, unbiased assessment of water quality and biotic condition
- Multiple uses:
  - Integrated Water Quality Monitoring and Assessment Report to U.S. EPA (305 (b) report and 303 (d) list)
  - Assess 100% of Indiana's rivers & streams
  - Identify waterbodies not meeting designated uses
  - Identify parameters of concern and track changes over time
  - Refer smaller watersheds for targeted sampling
  - Determine extent, cause, and source of impairments
  - Prioritize watersheds across water quality management programs

First 3 Five-Year Cycles
1996 - 2000, 2001 - 2005, & 2006 - 2010

5 Great Lakes
(Ohio River Tributaries)

3 Upper Wabash River

4 Lower Wabash River
Kankakee River

1 West Fork
White River
Patoka River

2 East Fork White River
Whitewater River

5 Ohio River Tributaries
(Great Lakes)

0 20 40   80 Kilometers

0   20   40   80 Miles

Map Projection: UTM Zone 16 N   Map Datum: NAD83
Mapped By: JWood, Office of Water Quality, Frbruary 28, 2019

Current 9-Year Cycle: 2011 - 2019

8 Great Lakes

7 Upper Illinois River

5 Upper Wabash River

6 Lower
Wabash River

4
Great
Miami
River

1 West Fork
White River

3 East Fork
White River

2 Patoka River

9 Ohio River Tributaries

0 20 40   80 Kilometers

0   20   40   80 Miles

Data Sources – Obtained from the State of Indiana Geographic Information Office Library
Map Projection/Datum: UTM, Zone 16N/NAD83

IDEM Probabilistic Sites 1996-2018

Map Projection: UTM Zone 16 N Map Datum: NAD83
Mapped By: JWood, Office of Water Quality, February 26, 2019
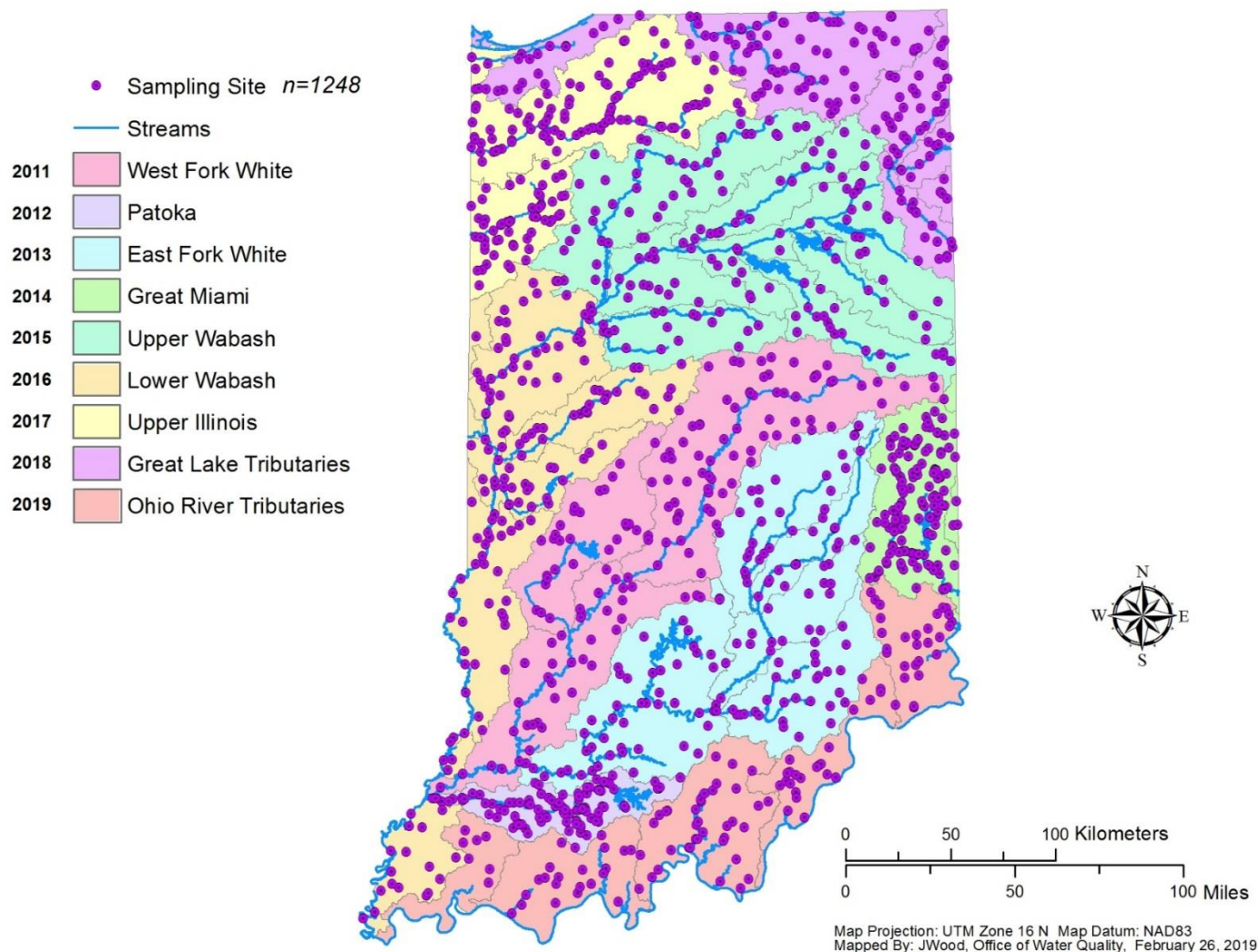
Sampling Methods

- Fish Community
  - 1 sample between June 1 – Oct. 15
  - Sample 15x wetted width, from 50m – 500m
  - Regional Indices of Biotic Integrity, 0 – 60 with <36 = impaired

- Macroinvertebrate Community
  - 1 sample between July 15 – Nov. 15
  - Multihabitat sampling over 50m
  - Identified to lowest taxonomic level
  - Statewide mIBI, 12 – 60 with <36 = impaired

- Ambient *Escherichia coli* concentrations
 - Sites sampled for five consecutive weeks April – Oct.

Sampling Methods

- Habitat Evaluations
  - Qualitative Habitat Evaluation Index (QHEI)
  - Range 0 – 100, with <51 = poor habitat

- Water Chemistry and Nutrients
  - 3 sampling events between May – Oct.
  - Field and laboratory water chemistry, metals, and nutrients
  - Nutrient Chlorophyll *a* measurements
    - Periphyton/Seston grab sample
    - Diatom IBI being developed
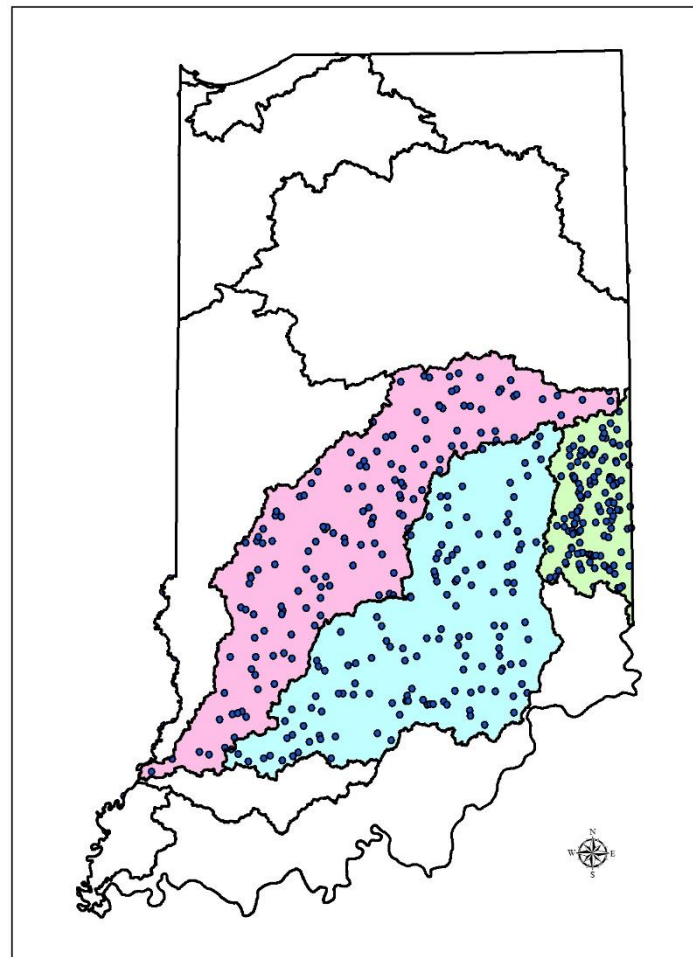 - Violations: Water Quality Standards
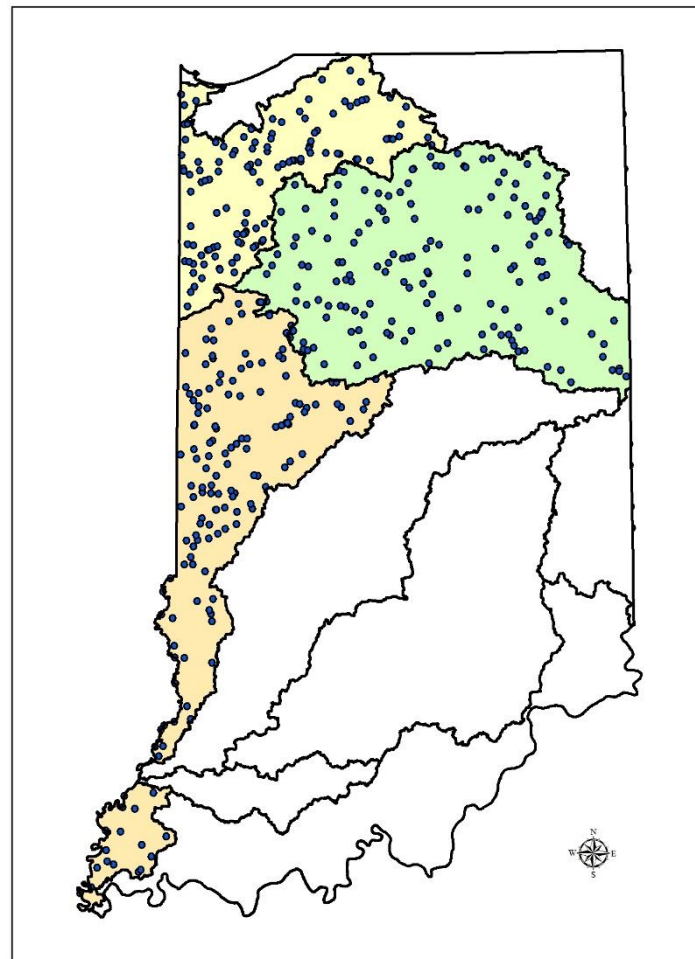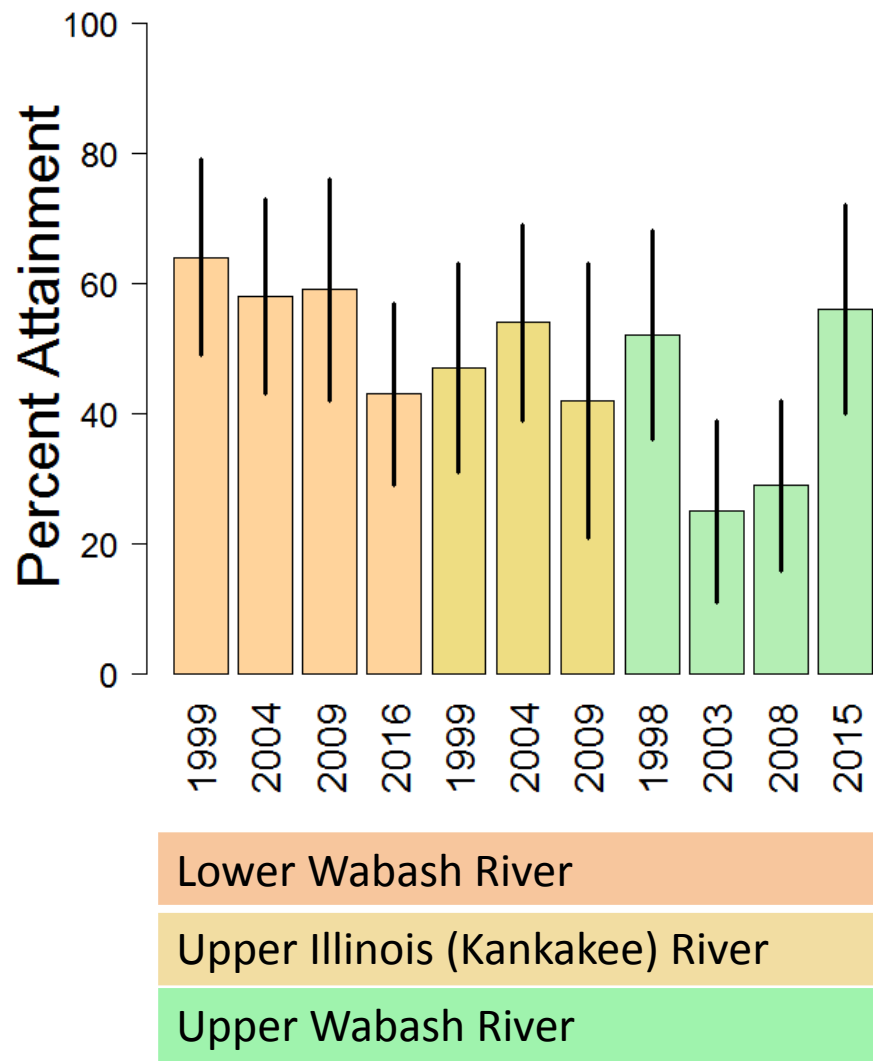
Probabilistic Sampling Results
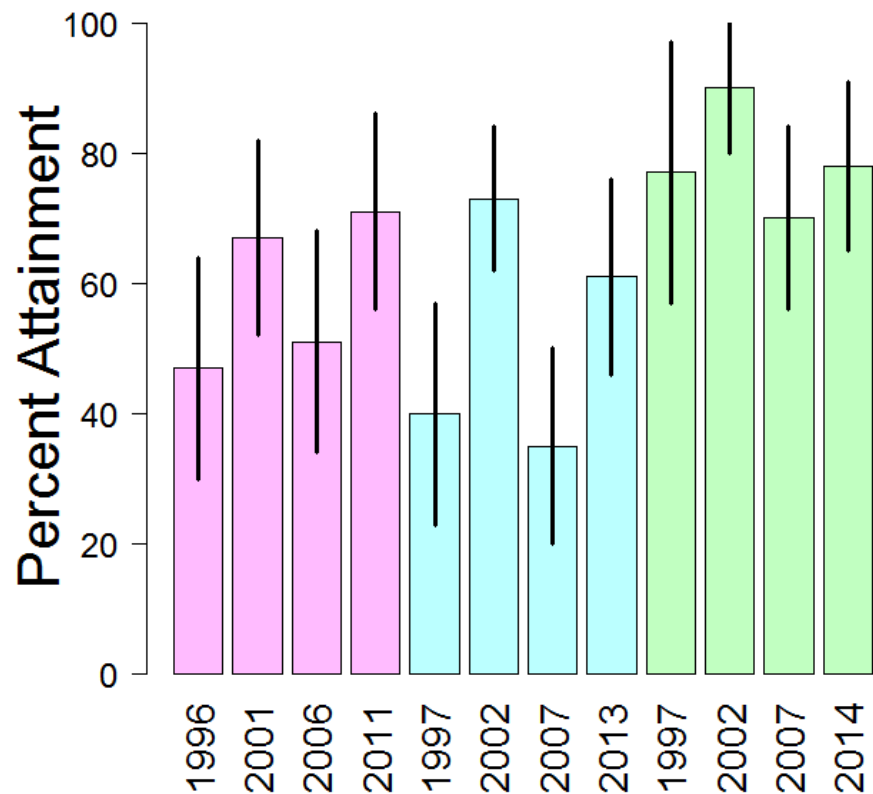
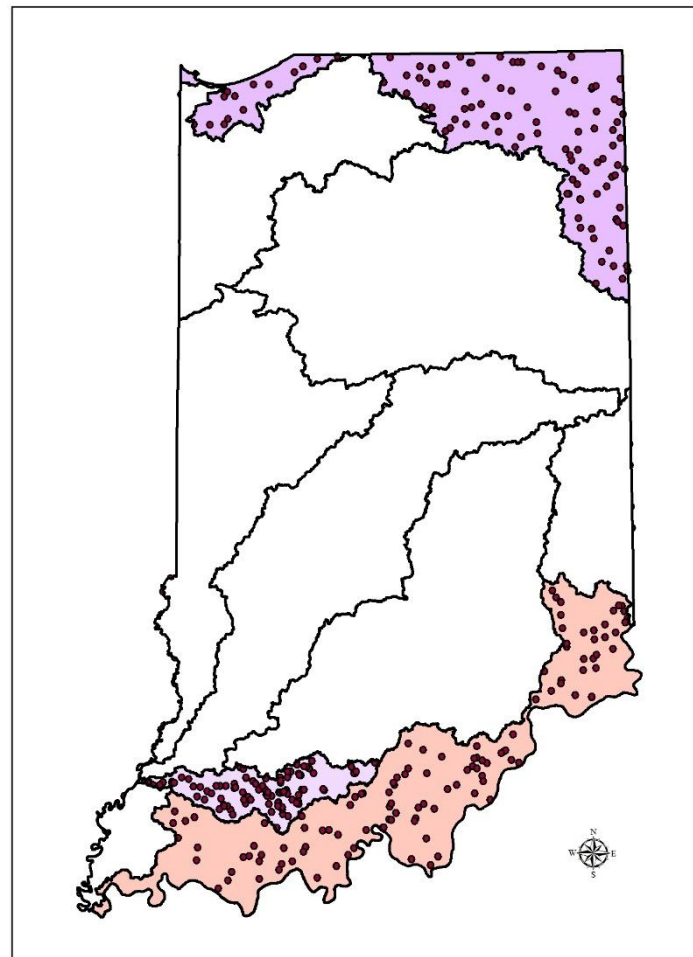West Fork of the White River

East Fork of the White River

Great Miami (Whitewater) River

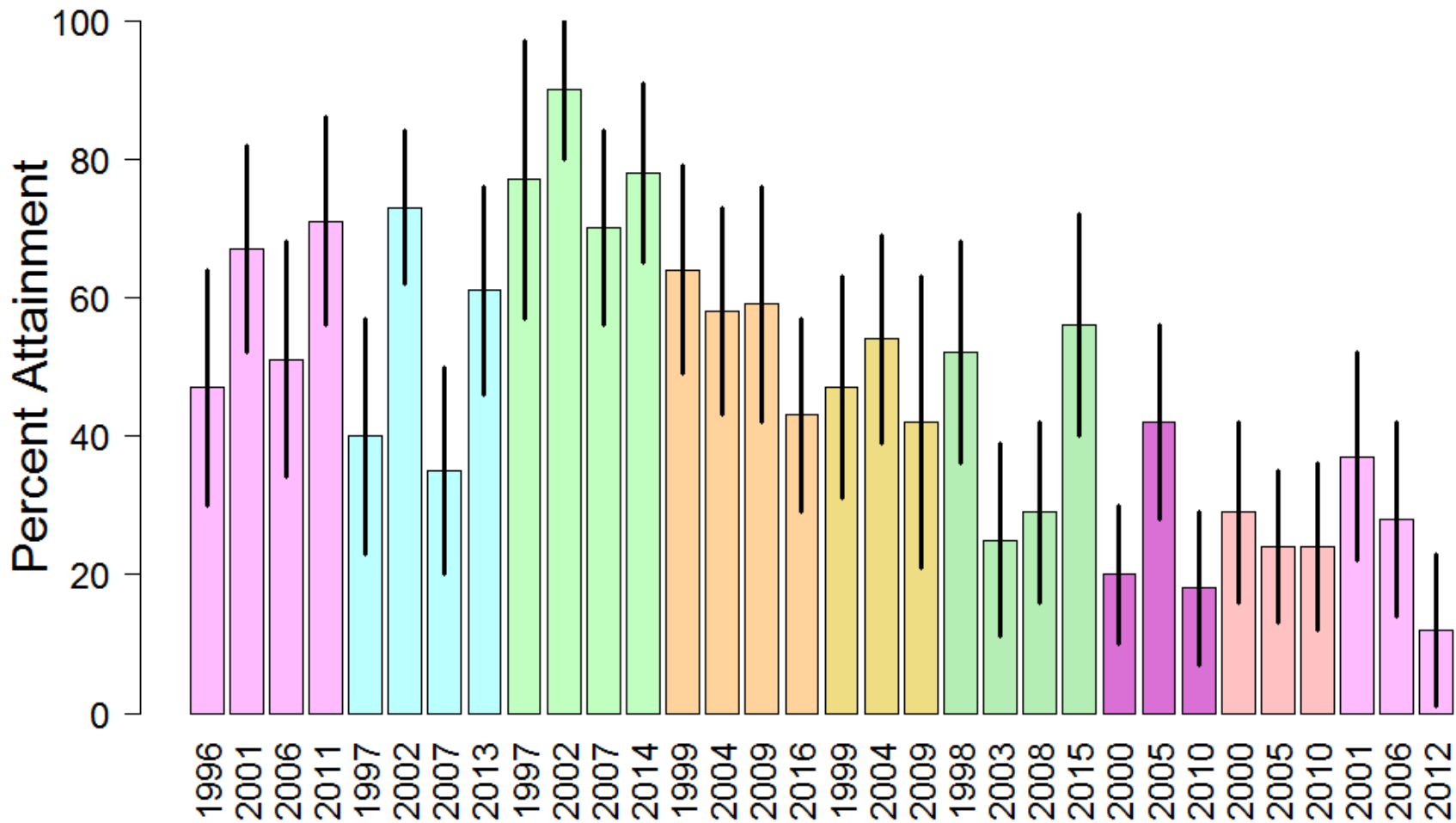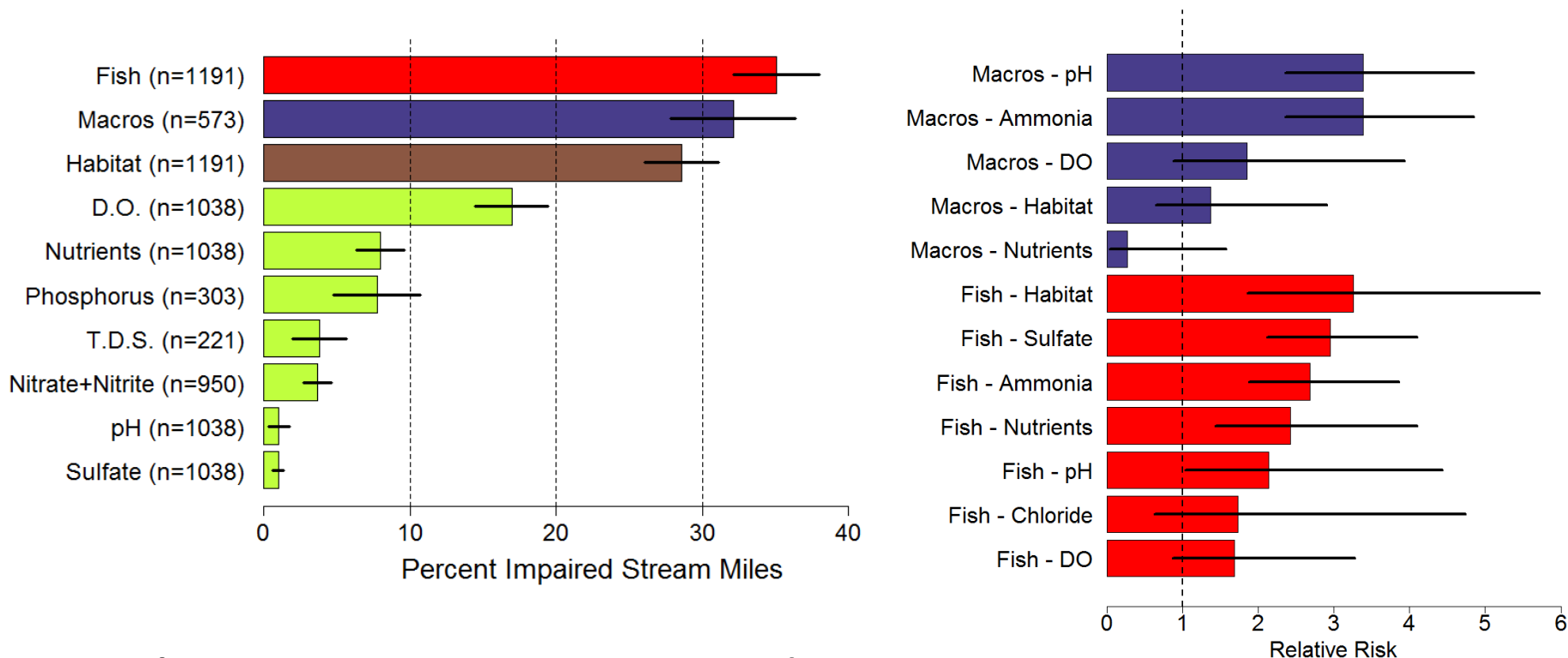# Probabilistic Sampling Results

Probabilistic Sampling Results

Great Lakes Tributaries

Ohio River Tributaries

Patoka River
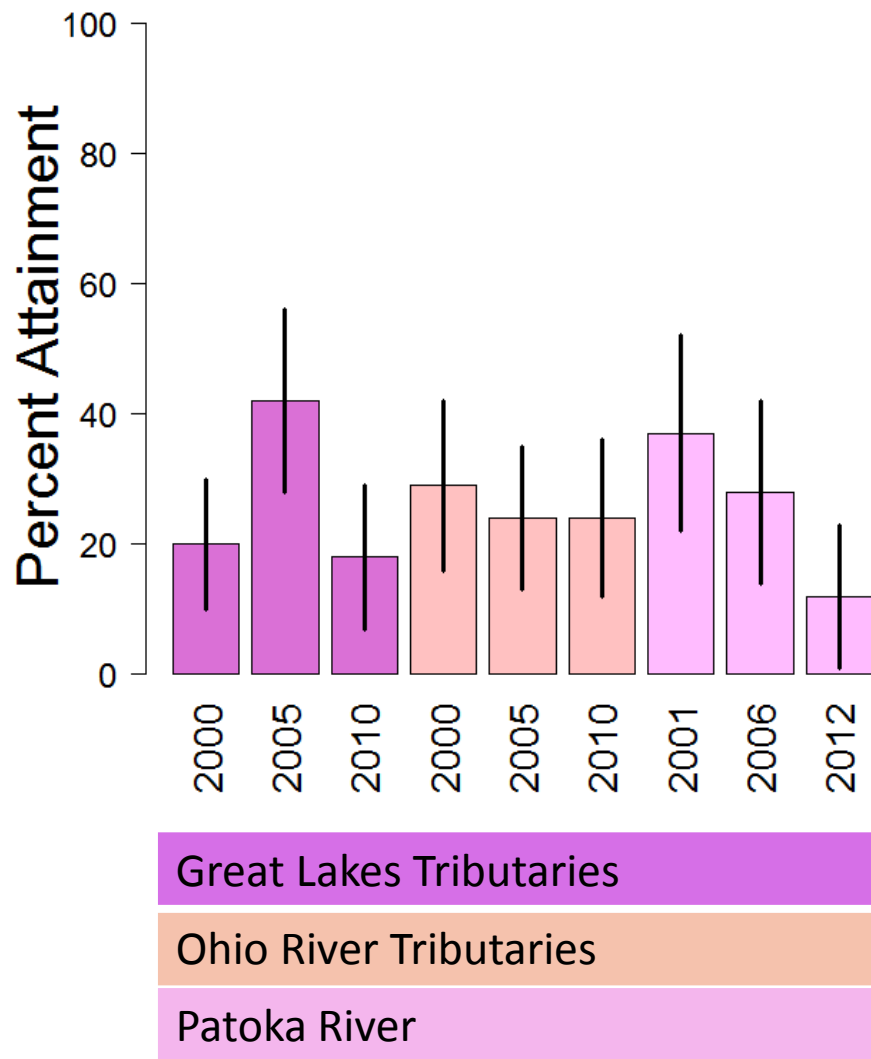
Probabilistic Sampling Results

- Aluminum, Ammonia, Cadmium, Chloride, Copper, Cyanide, Lead impact <1%
- pH, Ammonia, Habitat, Sulfate high risks to biology
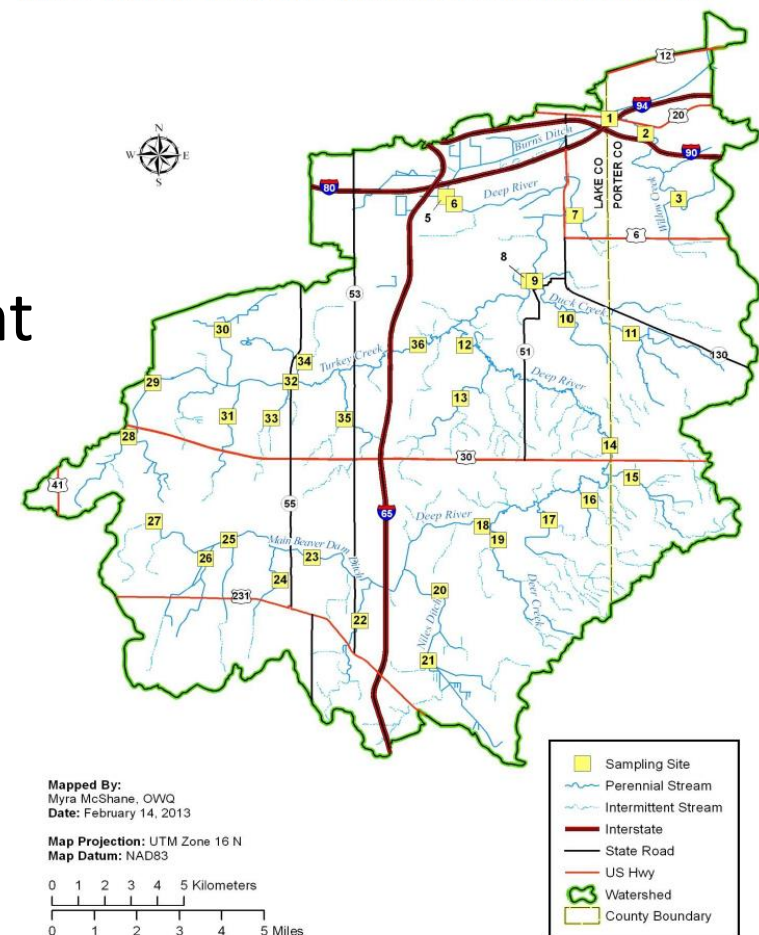
Probabilistic Sampling Results

Percent impacted Indiana stream miles by basin and parameter												
	Fish	Macro	Habitat	DO	Nutrients	Phosphorus	TDS	Nitrate + Nitrite	pH	Sulfate	Lead	Ammonia
West Fork of the White River	**29.6**	**23.8**	**23.3**	5.8	9.5	9.1	5.5	**12.3**	1.7	2.6	0.9	1.5
East Fork of the White River	**37.4**	**26.4**	**21.6**	**26.1**	1.6	5.4	2.0	0.8				0.6
Great Miami River	8.3	8.5	8.1	**13.8**	8.8			1.3				
Lower Wabash River	**25.3**	**30.7**	**22.1**	4.4	**10.0**	3.1		3.3	0.8			
Upper Illinois River	**30.3**	**39.0**	**52.0**	9.8	6.0	7.4		5.8	0.3			
Upper Wabash River	**34.8**	**28.3**	**34.2**	10.9	9.5	**12.1**		2.2			1.0	1.0
Great Lakes Tributaries	**55.1**	**62.2**	**43.7**	**19.4**	6.4							2.2
Ohio River Tributaries	**46.2**	**43.5**	**31.2**	**50.2**	9.0				4.4			
Patoka River	**46.1**	**49.6**	**61.5**	24.5	**15.4**	10.9	32.7	2.4	4.2	**19.3**	3.5	1.1

Targeted Sampling

- Watershed characterization collects same parameters using modified geometric design

- Used to determine impairment source/extent to develop TMDLs and provide data to local watershed groups

- Watershed groups then use 319 grants to implement Best Management Practices

Figure 2. Deep River - Portage Burns Watershed Baseline Monitoring Sampling Area

Mapped By:
Myra McShane, OWQ
Date: February 14, 2013

Map Projection: UTM Zone 16 N
Map Datum: NAD83

0 1 2 3 4 5 Kilometers

0 1 2 3 4 5 Miles

Sampling Site
Perennial Stream
Intermittent Stream
Interstate
State Road
US Hwy
Watershed
County Boundary

Watershed Report Card
Deep River Watershed Characterization (2013)

L-Site #	Location	Drainage Area (mi^2)	MIBI	IBI	QHEI	E. coli * (per 100mL)	Chemical Stressors Dissolved Oxygen (DO)# (mg/L)	Total Phosphorous# (mg/L)	Potential Cause(s) of Impairment
Headwaters Main Beaver Dam Ditch (40400010501)									
Main Beaver Dam Ditch									
LMG-05-0022	Blaine Street	2.35	28	40	27	465	3.92	0.25	Habitat; DO; Nutrients
LMG-05-0020	Clark Road	9.86	26	28	37	387	2.99	0.24	Habitat; DO; Nutrients
Tributary of Main Beaver Dam Ditch									
LMG-05-0021	101st Avenue	4.99	26	12	40	458	1.52	0.42	Habitat; DO; Nutrients
LMG-05-0019	Summit Street	2.79	24	14	26	1452	1.45	0.24	Habitat; DO; Nutrients
Main Beaver Dam Ditch-Deep River (40400010502)									
Main Beaver Dam Ditch									
LMG-05-0018	Grant Street	19.07	26	36	58	392	6.21	0.65	Nutrients
Deep River									
LMG-05-0015	Clay Street	44.48	40	34	57	978	6.63	0.38	Nutrients
Smith Ditch									
LMG-05-0036	113th Avenue	2.97	38	38	25	777	6.18	0.15	Habitat; DO
Niles Ditch									
LMG-05-0017	121st Avenue	7.24	20	12	33	250	2.44	0.47	Habitat; DO; Nutrients

Performance Monitoring

- Targeted sampling at previously sampled sites

- Limited to parameters for which site was impaired

- Conducted several years after implementation of Best Management Practices

- Fish IBI scores increased to passing (≥36) for all sites

	Bull Run			West Creek		
	101st Ave.(1)	101st Ave.(2)	Olcott Ave.	109th Ave	125th Ave.	Homestead Park/ Northcote Ave.
1999-Probabilistic	0					
2004-Probabilistic						16
2005-Singleton Ditch		24	20	28	32	
2011-Success Stories	38	38	38	36	36	36

- Acknowledgments
  - IDEM Watershed Assessment and Planning Branch
  - Tony Olsen, U.S. EPA

- Additional information
  - Watershed Assessment and Planning Branch
    www.idem.IN.gov/cleanwater/2338.htm
  - Water Monitoring Strategy
    www.idem.IN.gov/cleanwater/2537.htm
  - Watershed Restoration Success Stories
    www.idem.IN.gov/nps/3360.htm

Questions?